REMARKS

The present application has been reviewed in light of the Office Action dated March 25, 2003. Claims 1-15 are presented for examination, of which Claims 1, 4, and 10 are in independent form. Favorable reconsideration is respectfully requested.

The Office Action indicates that Claims 1-7 and 10-13 are rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,571,749 (Matsuda et al.) in view of U.S. Patent No. 6,028,264 (Yamazaki '264) and U.S. Patent No. 5,556,794 (Yamazaki '794); that Claims 8 and 14 are rejected under § 103(a) as being unpatentable over Matsuda et al. in view of Yamazaki '264 and Yamazaki '794, and further in view of Japanese Publication No. 2000-077694 (Tokawa); and that Claims 9 and 15 are rejected under § 103(a) as being unpatentable over Matsuda et al. in view of Yamazaki '264 and Yamazaki '794, and further in view of Japanese Publication No. 11-310495 (Kondo).

Applicants respectfully traverse the rejections, and submit that independent Claims 1, 4, and 10, together with the claims dependent thereon, are patentably distinct from the cited prior art for at least the following reasons.

An aspect of the present invention set forth in Claim 1 is directed to a process for forming a silicon-based thin film by high-frequency plasma CVD (chemical vapor deposition). The process utilizes a material gas that includes silicon fluoride and hydrogen. Oxygen atoms are incorporated in the material gas at a concentration of from 0.1 ppm to 0.5 ppm, based on a concentration of silicon atoms.

One of the notable features of Claim 1 is that the process utilizes an oxygen

content in the material gas within a range of 0.1 to 0.5 ppm, based on the concentration of silicon atoms. By virtue of this feature, the silicon-based thin film formed by the process has an enhanced crystallinity and crystal orientation. That is, by controlling the oxygen content in the material gas to within the specified range, intensification of crystallinity and crystal orientation in the silicon-based thin film is achieved. (The mechanism of the present invention is explained in the specification at, for example, page 7, line 8, to page 10, line 10, which discusses why oxygen must be contained in a material gas in a specified amount.)

Matsuda et al. relates to a plasma CVD process in which the substrate temperature changes rapidly before and after deposition to prevent diffusion of impurities. The Office Action cites Matsuda et al. for disclosing "a method for producing silicon thin films, particularly for use in solar cells, using high-frequency plasma CVD," but concedes that Matsuda does not disclose the use of a material gas with the range of oxygen content claimed in Claim 1.

Yamazaki '264 and Yamazaki '794 relate to methods for producing silicon semiconductor layers for photoelectric devices. These references are understood to teach that by reducing the oxygen content in a silicon layer the density of recombination centers in the silicon layer is reduced. More specifically, these references are understood to teach removing as much oxygen as possible from gases used to form the silicon layer by "passing a semiconductor raw material gas through a molecular sieve or zeolite which adsorbs oxygen . . . " (See, for example, column 6, lines 20, *et seq.* of Yamazaki '264.)

Applicants submit that a combination of Matsuda et al., Yamazaki '264, and Yamazaki '794, assuming such combination would even be permissible, would fail to teach or

suggest a process for forming a silicon-based thin film, wherein a material gas of silicon fluoride and hydrogen is used, and wherein the material gas contains an oxygen content of 0.1 to 0.5 ppm, based on the concentration of silicon atoms, as claimed in Claim 1.

As discussed above, Yamazaki '264 and Yamazaki '794 are understood to teach the use of a molecular sieve or zeolite to adsorb and remove as much oxygen as possible from the gases used to form a silicon layer. The purpose of the oxygen removal is to reduce the density of recombination centers in the silicon layer. Therefore, one of the goals of the Yamazaki references, which is to remove all oxygen, is in direct contrast to the feature of Claim 1 discussed above, which is to include a specific oxygen content of 0.1 to 0.5 ppm in a material gas used to form a silicon-based film. This oxygen-content range provides the benefit of enhancing the crystallinity and the crystal orientation of the silicon-based film.

Applicants respectfully submit that one of ordinary skill in the relevant art would find no suggestion in the Yamazaki references to use a material gas with an oxygen content within the specified range claimed in Claim 1, but instead would find a clear teaching to remove as much oxygen as possible.

Section 8 of the Office Action states, in relevant part, that the Yamazaki references "seek to reduce the amount of oxygen in the final silicon film using zeolites. This reduction results in a concentration of oxygen within the range recited in the instant claims. Since the final silicon film product has the same concentration as the silicon film in the instant claims, it is expected that the material gas would also have an oxygen concentration within the claimed range. This expectation is justified because the concentration of components in the

material gas directly affects the concentration of components in the final film. In other words, in a plasma CVD process, the concentration of components in a film is directly dependent on the concentration of the material gas. A different oxygen concentration would have yielded a different concentration of oxygen in the deposited layer."

Applicants respectfully disagree with the above characterization of plasma CVD processes. Attached hereto is a graph formed by plotting the values of oxygen concentration in thin films and oxygen concentration in material gases used to form the thin films. In the graph, the abscissa shows the oxygen concentration in a material gas, and the ordinate shows the oxygen concentration in a thin film. The dots are plotted using the values of oxygen concentration in a material gas shown in Table 2, on page 33 of the specification, and the values of oxygen concentration in a thin film shown in Table 3, on page 34 of the specification. As can be seen from the attached graph, the oxygen concentrations in the thin films do not vary directly with the oxygen concentrations in the material gases used to form the thin films. Therefore, the conclusions asserted in section 8 of the Office Action are respectfully submitted to be inaccurate.

In summary, an object of the method of Claim 1 is to form silicon-based films having a high crystallinity and an enhanced crystal orientation at a high rate. To achieve this object, a specified amount of oxygen is contained in a material gas used to form the silicon-based films. In contrast to Claim 1, the Yamazaki references disclose that the oxygen concentration in silicon films should be reduced as much as possible, in order to suppress defects in the silicon films.

Accordingly, Applicants submit that Claim 1 is patentable over the cited art, and respectfully request withdrawal of the rejection under 35 U.S.C. § 103(a). Independent Claims 4 and 10 include a feature similar to that discussed above, in which a specified content of oxygen is incorporated in a material gas of silicon fluoride and hydrogen, which is used to form a silicon-based layer. Therefore, those claims also are believed to be patentable for at least the same reasons as discussed above.

The other rejected claims in this application depend from one or another of the independent claims discussed above and, therefore, are submitted to be patentable for at least the same reasons. Since each dependent claim is also deemed to define an additional aspect of the invention, individual reconsideration of the patentability of each claim on its own merits is respectfully requested.

Finally, the provisional rejection of Claims 1-15 under the judicially created doctrine of obviousness-type double patenting, as being unpatentable over Claims 1-16 of U.S. Patent Application No. 09/865,549 in view of U.S. Patent No. 6,028,264 (Yamazaki '264) and U.S. Patent No. 5,556,794 (Yamazaki '794), has been noted. In view of the fact that Application No. 09/865,549 has not yet been allowed, Applicants respectfully defer responding to the double-patenting rejections at this time.

This Response After Final Action is believed clearly to place the present application in condition for allowance and, therefore, its entry is believed proper under 37 C.F.R. § 1.116. Accordingly, entry of this Response, as an earnest effort to advance prosecution and reduce the number of issues, is respectfully requested. Should the Examiner believe that issues

remain outstanding, it is respectfully requested that the Examiner contact Applicants' undersigned attorney in an effort to resolve such issues and advance the case to issue.

In view of the foregoing remarks, Applicants respectfully request favorable reconsideration and early passage to issue of the present application.

Applicants' undersigned attorney may be reached in our New York Office by telephone at (212) 218-2100. All correspondence should continue to be directed to our address listed below.

Respectfully submitted,

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